(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 186 620 A2**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 85730173.3

(22) Date of filing: 23.12.85

(51) Int. Cl.⁴: B 41 F 33/00
B 41 F 31/02

(30) Priority: 24.12.84 JP 271053/84
03.06.85 JP 118927/85

(43) Date of publication of application:
02.07.86 Bulletin 86/27

(84) Designated Contracting States:
DE FR GB IT SE

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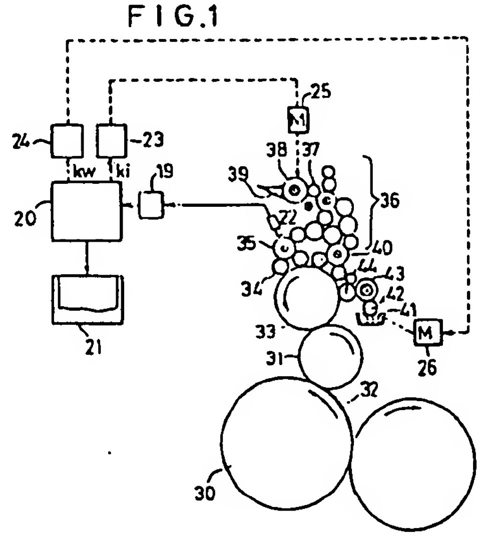
(54) **Method of controlling film thickness of mixture liquid layer of oil material and water in printer.**

(57) A method of controlling film thickness of a mixture liquid layer of oil material and water in a printer such as, for example, an offset printer is disclosed wherein the mixture liquid layer of the oil material containing printing ink, printer's varnish and the like and water such as, for example, dampening water attached to one roller of a roller group carrying the mixture liquid layer is alternately irradiated by infrared rays which are most strongly absorbed into the oil material and the water and by infrared rays which are hardly absorbed into the oil material and the water. Film thicknesses of the oil material and the water are detected on the basis of infrared absorption characteristics of the oil material and the water. The detected film thicknesses of the oil material and the water are compared with the respective predetermined target values and supply of the oil material and the water is controlled so that differences between the detected film thicknesses and the respective target values are minimized. Thus, printing failure such as so-called greasing and water stain occurring in a prior art printing is prevented and printing quality is improved, so that spoilages can be reduced.

FIG.1



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BACKGROUND OF THE INVENTION

(i) FIELD OF THE INVENTION

The present invention relates to a method of automatically controlling film thickness of a mixture liquid layer in a device, which supplies mixture liquid of oil material and water, such as an ink and dampening water feeder and a varnish coating device for use in a printer, particularly an offset printer.

(ii) PRIOR ART STATEMENT

In an offset printer, it is necessary to make printing while supply of ink and dampening water is optimally maintained as well known. However, thickness of the ink and the dampening water is greatly varied depending on variation of speed of a printing machine and ambient temperature. When film thickness of ink is varied, ink density on a printed matter is changed. When the balance of ink and dampening water is changed, printing failure such as so-called greasing and water stain occurs. A printed matter having the printing failure is treated as a spoilage and if a percentage of the spoilages is increased, a printing cost goes up.

Various manners for reduction of the spoilages caused by the variation of supply of the ink and the dampening water have been proposed heretofore. One of them is disclosed in in Japanese Patent Publication No. 52-37402, in which ink and dampening water on a form cylinder are

irradiated by light passing through a special filter and having the range of visible rays and light absorption characteristic of the ink is utilized to determine film thickness of the ink. At the same time, light absorption characteristic of the dampening water is utilized to determine film thickness. Thus, supply of the ink and the dampening water is controlled on the basis of the measured results.

However, in the conventional manner of automatically controlling the ink and the dampening water in the offset printer described above, the film thickness of the ink is determined by the absorption characteristic of the light having the range of visible rays but the absorption characteristic is different depending on types of ink, particularly color of the ink. Accordingly, the measured value of the film thickness is widely different depending on types of the ink and it takes much time to control the film thickness. Further, the measured value is greatly influenced by outside light leaking into a measuring portion from the outside and hence it is difficult to determine the film thickness of the ink exactly.

Furthermore, a conventional varnish coating device does not control film thichness of the varnish to be constant by detecting the film thickness of the varnish being fed. Operators change a rotational number of a feeding roller properly on the basis of their own experience and judgment to

adjust the film thickness. Accordingly, variation of the film thickness due to change of environmental conditions such as temperature can not be followed exactly.

SUMMARY OF THE INVENTION

The present invention is made in view of the above defficiencies.

(I) It is an object of the present invention to provide a method of controlling film thickness of a mixture liquid layer in which the film thickness of the mixture liquid layer of oil material and water in a printer is exactly measured so that the same measured values are always obtained regardless of types of the oil material and variation thereof is correctly determined in a short time so that the film thickness can be controlled reliably.

(II) It is another object of the present invention to provide a method of controlling film thickness of a mixture liquid layer in which supply of ink or varnish and water or dampening water fed to a printer is always maintained to an optimum state to prevent printing failure such as so-called greasing and water stain occurring due to variation of supply of the ink or the varnish and the water or the dampening water.

In order to achieve the above objects, the present invention is configured as follows.

The method of controlling film thickness of a

mixture liquid layer of oil material and water in a printer is characterized in that the mixture liquid layer of the oil material containing ink or varnish and the water containing dampening water attached on one roller made of material having a surface which is difficult to absorb infrared rays, of a roller group carrying the mixture liquid layer of the oil material and the water is alternately irradiated by infrared rays which are most strongly absorbed into the oil material and the water and by infrared rays which are hardly absorbed into the oil material and the water. Film thicknesses of the oil material and the water are detected on the basis of infrared absorption characteristics of the oil material and the water. The detected film thicknesses of the oil material and the water are compared with the respective predermined target values and supply of the oil material and the water is controlled so that differences between the detected film thicknesses and the respective target values are minimized.

The present invention possesses the following effects since the above configuration is provided.

The film thickness of the mixture liquid layer of the oil material and the water in the printer is detected in no contact manner irrespective of types of the oil material and the film thickness can be automatically controlled to be a predetermined target value.

Supply of the oil material containing ink or

5

varnish and supply of the water containing the dampening water fed to the printer can be always maintained to an optimum state and printing failure such as so-called greasing and water stain occurring due to variation of supply of the oil material and supply of the water can be prevented, so that spoilages can be reduced.

Further, a predetermined film thickness can be stably obtained at all times regardless of variation of environmental conditions such as temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 schematically illustrates an embodiment implementing the present invention in automatic control of film thickness of ink and dampening water in an offset printer;

Fig. 2 is a graph showing a relation of wavelength of infrared rays and transmittances of ink and water;

Fig. 3 schematically illustrates another embodiment implementing the present invention in automatic control of film thickness of varnish and water in a varnish coating device;

Fig. 4 is a graph of a relation of wavelength of infrared rays and transmittances of varnish and water; and

Fig. 5 is an enlarged side view of a portion of a film detection apparatus for use in the above embodiments of the automatic control.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Preferred embodiments of the present invention are now described on the basis of the drawings.

(First Embodiment)

An embodiment implementing the present invention in automatic control of film thickness of a mixture liquid layer of ink and dampening water in an offset printer is described with reference to Figs. 1, 2 and 5. Describing the offset printer with reference to Fig. 1, the offset printer comprises an impression cylinder 30, a blanket cylinder 31, a plate cylinder 33, an inking device including a form roller 34, inking rollers 36, an ink ductor 37, an ink fountain roller 38 and an ink fountain 39, and a damping water device including a damping water tank 41, a water fountain roller 42, a roller 43 and a form damping roller 44. Thus, printing is made on printing paper 32. In the automatic control apparatus, while a metal roller 35 or 40 of the inking rollers 36 measures the film thickness of the ink and the dampening water, the metal roller may be replaced with other ink roller formed of material which is difficult to absorb infrared rays. Further, a sampling roller may be provided in the inking rollers 36 to measure the film thickness of the ink and the dampening water.

The automatic control apparatus is decribed with reference to Figs. 1 and 5. In Fig. 5, numeral 10 denotes an

infrared emitting element, 11 a lens, 12 an interference filter, 13 a light guide pipe, 14 the mixture liquid layer of the ink and the dampening water existing on the metal roller 35, 15 a photoelectric element (a measuring device or a detector) disposed in the vicinity of the metal roller 35, 16 an amplifier, 18 a synchronizer, 19 an A/D converter, 20 a computer and 21 a plotter. In Fig. 1, numerals 23 and 24 denote D/A converters, 25 a motor for driving the ink fountain roller and 26 a motor for driving the water fountain roller.

Operation is now described. First of all, description is made to a reason why the infrared rays are used to detect the film thickness of the ink and the dampening water. When light illuminates on a material, the material absorbs light having a particular wavelength and remaining light is accordinglyl observed as a color of the material. The absorption of light having the particular wavelength is effected to not only a range of visible rays but also a range from ultraviolet rays to infrared rays. Since an infrared absoption spectrum in the wavelength range of 2.5 μm to 10 μm has clear correlation of the absoprion characteristic and the molecular structure, it is most suitable obtain knowledge concerning compound structure. Curves 1 and 2 of Fig. 2 show infrared absorption spectra of the ink and the dampening water in the wavelength range of 2.5 μm to 10 μm measured by an infrared spectrophotometer.

Representative absorption zones for the ink in the above spectrum exist in three wavelengths of 3.40 µm (see 3 of Fig. 2), 5.40 µm (see 4) and 6.85 µm (see 5). The facts are due to the molecular structure of vehicle in the ink and is not related to a color of pigment. That is, an offset ink generally used exhibits the almost same absorption characteristic and measurement can be performed in the same absorption zone independently of types of ink. Absorption zones for the water exist in three wavelengths of 2.96 µm (see 6 of Fig. 2), 4.80 µm (see 7) and 6.10 µm (see 8). An actual measurement uses the wavelengths most strongly absorbed, of these absorption wavelengths, that is, the wavelength of 3.40 µm for the ink and the wavelength of 2.96 µm for the water.

Description is now made to a rate of the absorbed infrared rays into material. The rate is related to thickness and density of a layer of a material. An index representing the rate of the absorption generally uses transmittance represented by a ratio of intensity Io of incident light and intensity I of transmitted light and the transmittance is proportional to the thickness and the density of the layer. Using this principle, if light having particular wavelength passing through a filter, of the infrared rays illuminates an ink roller to measure quantity of light reflected from a surface of the roller, the film thickness of the ink and the percentage of water content can be detected.

Fig. 5 shows a configuration of a detection device of film thickness of the oil material and the water for use in an embodiment of the present invention. While the detection device is a percentage meter of water content in film thickness of ink described in Japanese Patent Application No. 58-124418, since the infrared spectrum characteritic of printing ink of the embodiment and varnish of a second embodiment is almost identical, the detection device can be applied to both the embodiments.

The automatic control apparatus for ink and dampening water shown in Figs. 1 and 5 utilizes the above principle. Infrared rays emitted from the infrared emitting element 10 forming a light source are condensed by the lens 11 and then pass through the interference filter 12. The interference filter 12 is provided with three types filters of a filter for infrared rays absorbed into the ink, a filter for infrared rays absorbed into the dampening water and a filter for reference rays which are not absorbed into the ink and the dampening water. The infrared rays passing through the reference filter are used to correct a measured value in absorption of the infrared rays on a basic material of the roller and to correct the measured value in accordance with variation of a measurement distance between the light guide pipe 13 and the roller 35 due to mechanical vibration. The three types of filters are mounted in a chopper wheel so that infrared rays alternately illuminate the roller 35 by

rotation of the chopper wheel. Light passig through the interference filter illuminates emulsified ink 14 (that is, a mixture liquid layer of ink and dampening water) on the roller 35 through the light guide pipe 13. A portion of this light is absorbed into the emulsified ink while remaining light is reflected and condensed to the photoelectric element 15. The remaining light is converted to an electric signal by the photoelectric element 15 and the signal amplified by the amplifier 16 is supplied to the A/D converter 19. At this time, the rotational number of the roller 35 and the rotational number of the interference filter 12 are detected and the detected signals are supplied to the A/D converter 19 through the synchronizer 18. The digitized signals of the A/D converter 19 are supplied to the computer 20 together with other necessary signals to calculate the film thickness of the ink and the percentage of water content, which are supplied to the plotter 20. Further, control signals are applied from the computer 20 through the D/A converters 23 and 24 to the motor 25 for driving the ink fountain roller and the motor 26 for driving the water fountain roller to control the rotational numbers of the motors 25 and 26. At this time, control is made so that deviation $|ki - ki'|$ between a value ki representing the film thickness of the ink and a target value ki′ for optimum printing quality and deviation $|kw - kw'|$ between a value kw representing the percentage of water content and a targer value kw′ for

optimum printing quality are minimized.

As describe above, supply of the ink and the dampening water fed to the printer are always maintained to the optimum condition. Further, printing failure such as so-called greasing and water stain occurring due to variation of supply of the ink and the dampening water can be prevented and hence spoilages can be reduced.

(Second Embodiment)

Another embodiment implementing the present invention in automatic control of film thickness of a mixture liquid layer of varnish and water in a varnish coating device of a printer is now described with reference to Figs. 3, 4 and 5.

Referring to Fig. 3, the varnish coating device comprises a roller group composed of a rubber blanket cylinder 137, an intermediate cylinder 138, an impression cylinder 139, a delivery shaft 140, a varnish saucer 133, a fountain roll 134, an intermediate roller 135 and a form roller 136 and a varnish feeding unit composed of a varnish tank 130, a mixture tank 131, a water tank 132 and pumps 128, 129 and 127. Thus, coating is effected on a surface of printing matter. A detection device 22 for varnish and water, which is the same as the device shown in Fig. 5 described in the first embodiment, is provied in the vicinity of the roller 136 and output signals from the detection device 22

are supplied to the computer 20 through the A/D converter 19 to be processed in the computer 20. Data produced from the computer 20 are displayed in the plotter 21 and supplied as control signals through D/A converters 123, 124 and 125 to a rotation control motor 126, which drives the fountain roller 134 when the film thickness of the varnish is changed. Further, when density of the varnish is changed, the pumps 127 and 128 are operated. When liquid level in the mixture tank goes down, the pumps 127 and 128 are also operated.

Fig. 4 shows infrared absorption spectra of varnish and water in a wavelength range of 2.5 μm to 10 μm measured by an infrared spectrophotometer. As seen from the spectra, while representative absorption zones of the varnish exist in three wavelengths of 3.40 μm, 5.74 μm and 6.85 μm, varnish used in a printer exhibits similar characteristic independently of types of varnish and hence measurement can be made in the absorption zones having the same wavelengths. Absorption zones of water exist in three wavelengths of 2.96 μm, 4.80 μm and 6.10 μm. An actual measurement uses the wavelengths most strongly absorbed, of these absorption wavelengths, that is, the wavelength of 3.40 μm for the ink and the wavelength of 2.96 μm for the water.

The index representing the rate of the absorpted infrared rays into material generally uses transmittance as described above, and the transmittance is proportional to the thickness and the density of the layer. Using this

principle, if light having particular wavelength passing through a filter, of the infrared rays illuminates the varnish roller to measure quantity of light reflected from a surface of the roller, the film thickness of the ink and the percentage of water content can be detected. In other words, the film thicknesses of varnish and water on the surface of the roller are detected on the basis of infrared rays of wavelengths absorbed into and reflected by varnish and water.

The detection device of film thickness of varnish and water used in the present embodiment uses the film thickness detection device shown in Fig. 5 in the same manner as in the first embodiment. Accordingly, operation and processing of electric signals of the detection device are the same as those of the first embodiment and description thereof is omitted. In Fig. 5, numeral 14′ denotes a mixture liquid layer of varnish and water.

The film thickness of the varnish is controlled so that deviation $K = |k - k'|$ between the measured value k of the varnish film thickness and the target value k′ representing an optimum coating condition is minimized. The density of the varnish is also controlled so that deviation $D = |d - d'|$ between the measured value d of the varnish density and the target density d′ representing an optimum coating condition is minimized. By effecting control in this manner, that is, by sending a deviation up signal Dup when the density is increased and a deviation down signal Dn when

the density is decreased, variation of the film thickness and the density of the varnish due to variation of printing speed of the printing machine, ambient temperature and humidity can be minimized and stable coating with high quality is effected.

The measuring roller used in the present invention is not limited to the metal roller and may be other roller having small absorption for infrared rays. Further, measuring and control can be effected if the sampling roller is mounted in the roller group.

As described above, the varnish and the water on the roller in the printer are detected in non-contact manner to automatically control the rotational number of the feeding roller and the ratio of the varnish and the water, and the stable film thickness of the varnish an be obtained independently of environmental conditions.

While the typical preferred embodiments of the present invention has been described fully hereinbefore, it is to be understood that the present invention is not intended to be restricted to the details of the specific constructions shown in the preferred embodiments, but to contrary, many changes and modifications may be made in the foregoing teachings without any restriction thereto and without departing from the spirit and scope of the invention.

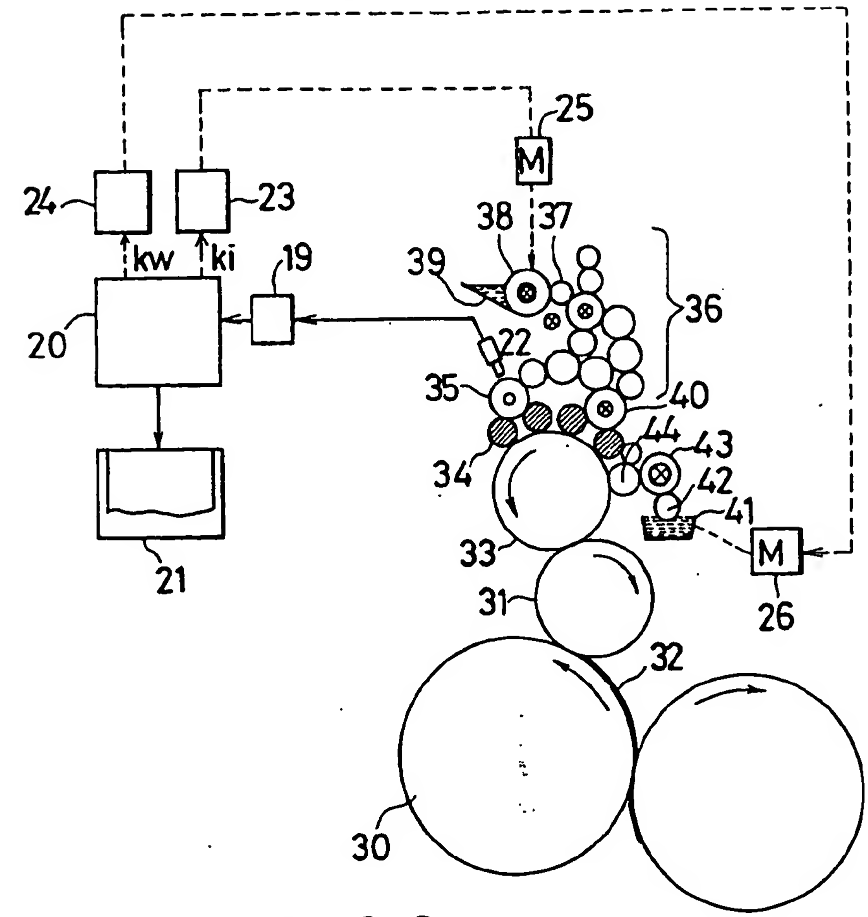
CLAIMS

1. A method of controlling film thickness of a mixture liquid layer of oil material and water in a printer, comprising steps of alternately irradiating infrared rays which are most strongly absorbed into the oil material and the water and infrared rays which are hardly absorbed into the oil material and the water on the mixture liquid layer of the oil material and the water existing on a roller of rollers carrying the mixture liquid layer of the oil material and the water in the printer, detecting the film thickness of the oil material and the water on the basis of infrared absorption characteristic of the oil material and the water, comparing the detected film thickness of the oil material and the water with respective predetermined target values to obtain deviation therebetween, and controlling supply of the oil material and the water so that the deviation is minimized.

2. A method according to Claim 1, wherein the oil material of the mixture liquid layer comprises ink.

3. A method according to Claim 1, wherein the oil material of the mixture liquid layer comprises varnish.

F I G.1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kw
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37
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41
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32
30

F I G.2

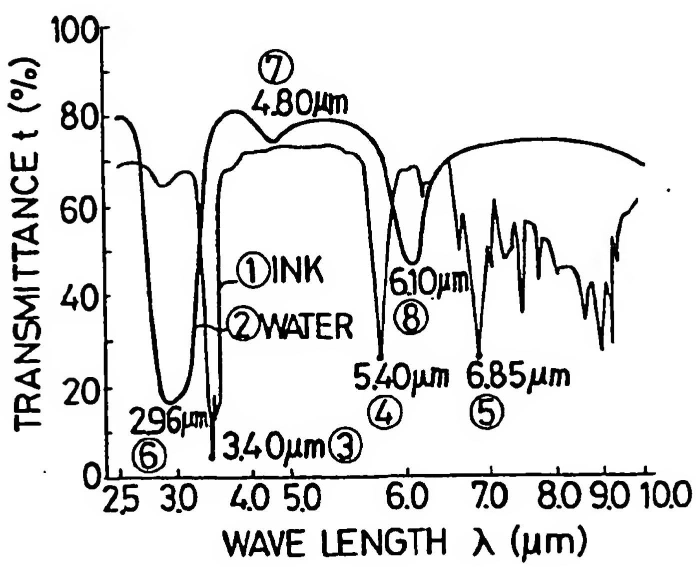
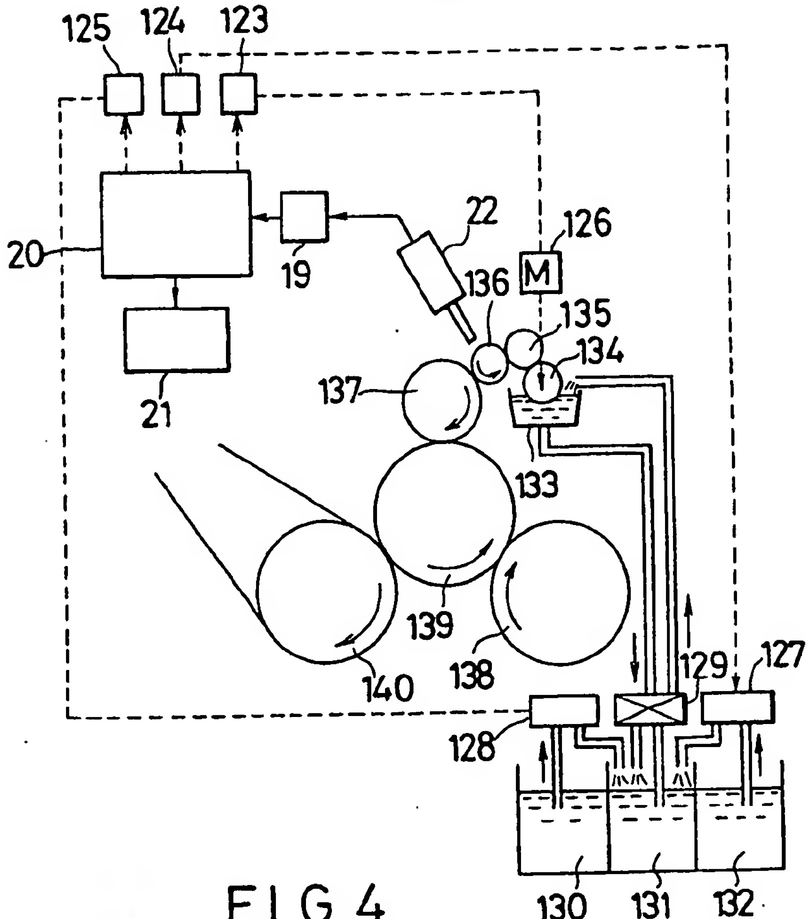

100
80
60
40
20
0
TRANSMITTANCE t (%)
⑦
4.80μm
①INK
②WATER
6.10μm
⑧
2.96μm
⑥
3.40μm③
5.40μm
④
6.85μm
⑤
2.5 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0
WAVE LENGTH λ (μm)

FIG 3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124
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20
19
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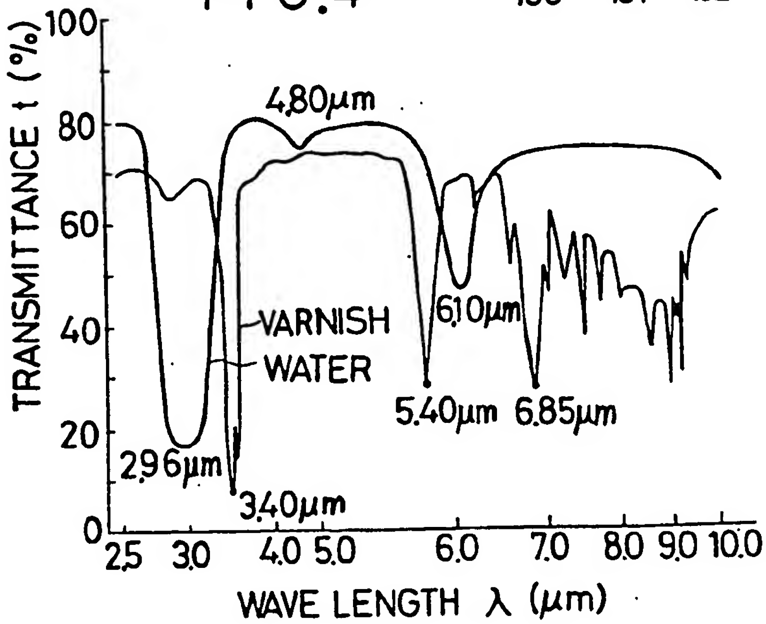
127
128
130
131
132

FIG.4


TRANSMITTANCE t (%)
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80
60
40
20
0
4.80μm
VARNISH
WATER
6.10μm
2.96μm
3.40μm
5.40μm
6.85μm
2.5
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
WAVE LENGTH λ (μm)

FIG.5